

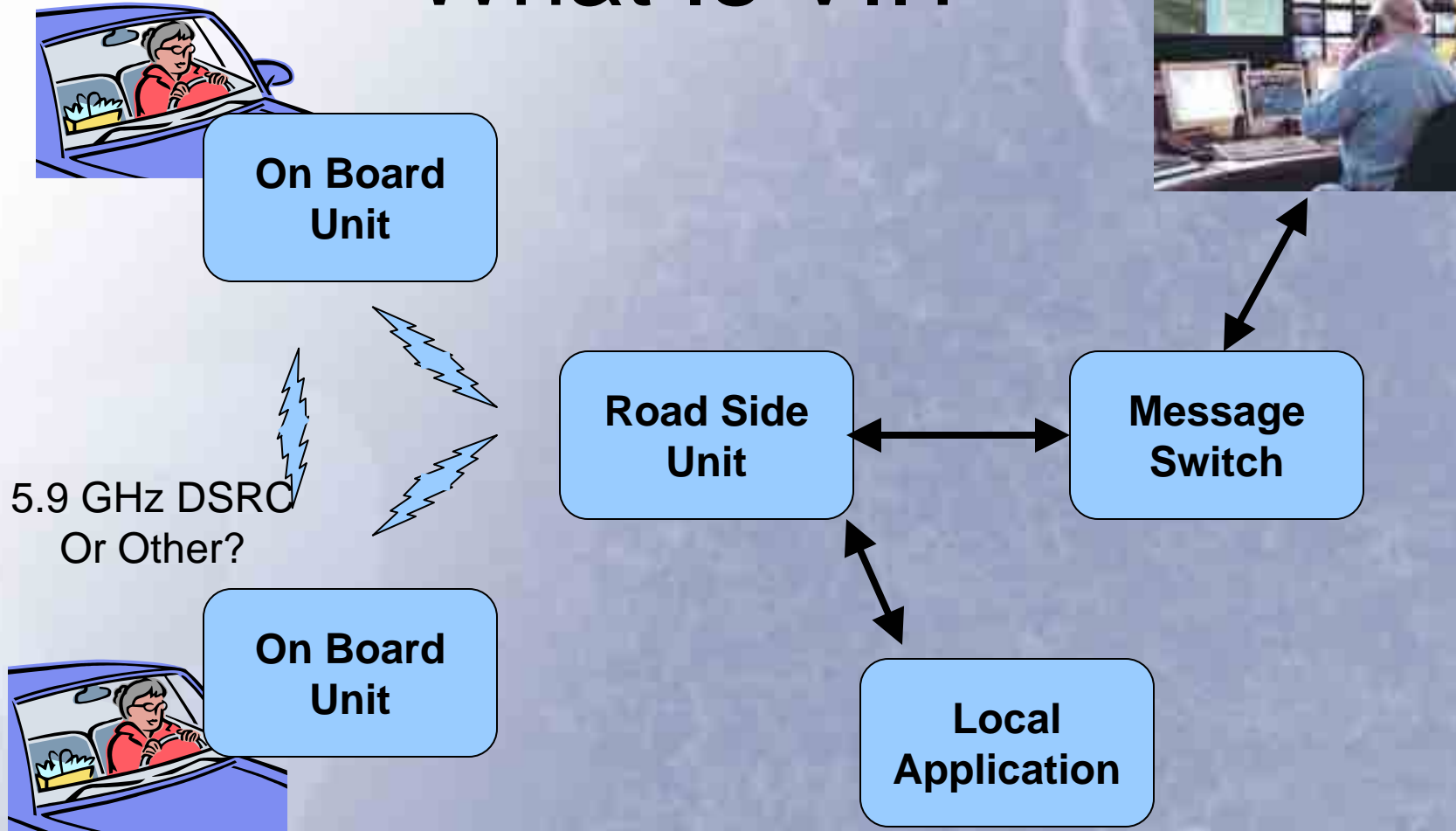
# Vehicle Infrastructure Integration

**Marthand Nookala, Division Director  
Minnesota Department of Transportation  
Mississippi Valley 2005**

# What is VII?

- 1 of 9 new Federal ITS Initiatives
- Enabling Communications Infrastructure:
  - Vehicle to Vehicle
  - Vehicle to Local Roadside
  - Vehicle to Center
- Integrated for Multiple Applications:
  - Safety, Mobility, Commercial

# What Is VII?



# Background of VII

- Intelligent Vehicle Initiative (“IVI”)
  - Vehicle Based Safety Systems
  - Infrastructure Support Would Help
    - Intersection Collision Prevention
    - Lane Departure Prevention
- Integrated Network of Transportation Information (“INTI”) or “Infostructure”
  - Sharing Real Time Transportation

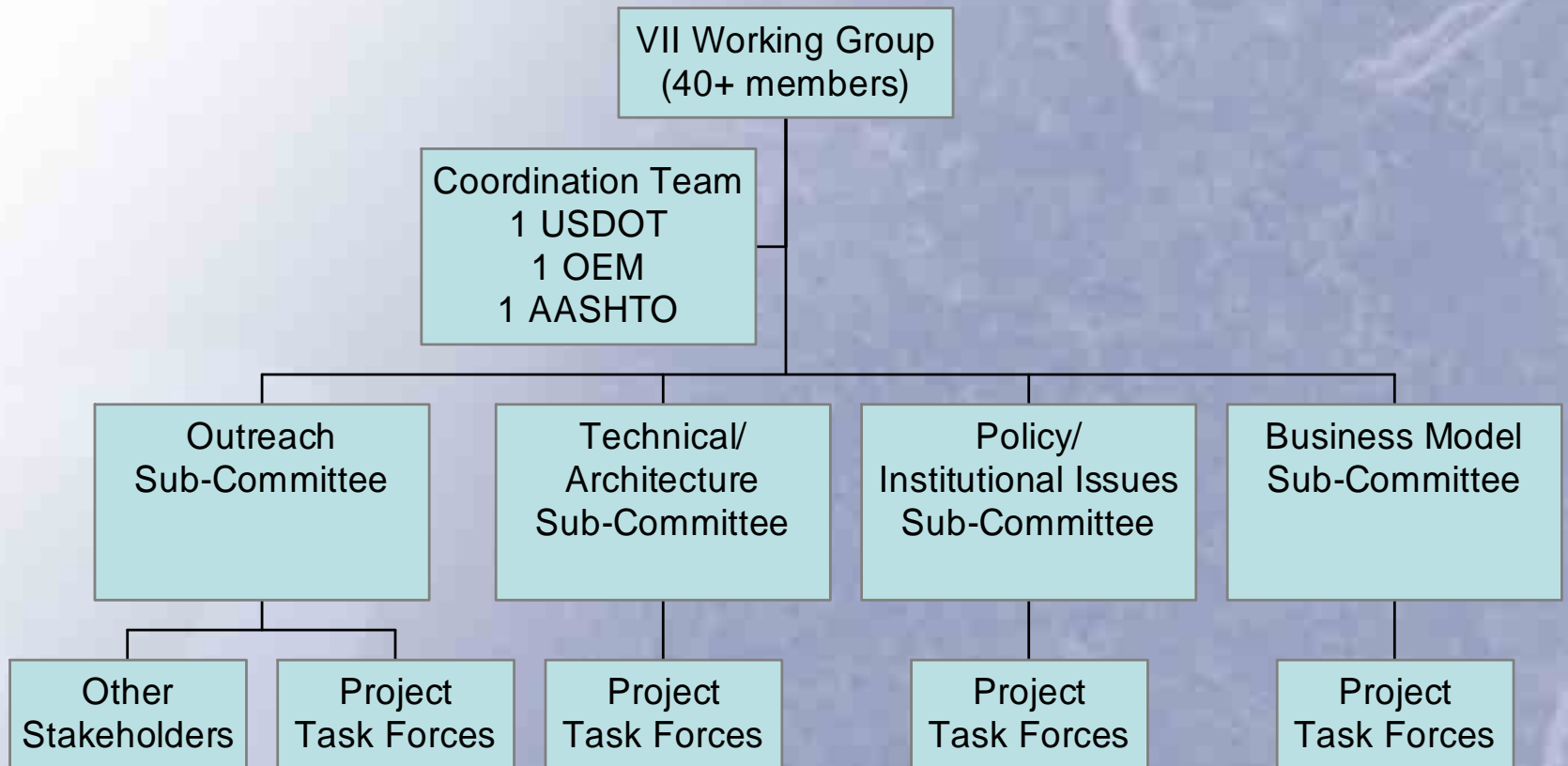
# Background of VII

- Cooperative Systems
  - Vehicle Systems Benefit from Infrastructure Support
  - Transportation Management Systems Benefit from Vehicle Data
- Integrated Systems
  - Multiple Applications Justify the Communications Infrastructure

# Background of VII

- Automotive Companies Interested
  - Supports Automotive Safety Efforts
  - Supports Commercial Efforts
    - Customer Relationship Management
    - Business/Entertainment Services
    - Third Party Applications
- Requires Equipment Investment in Vehicle and Infrastructure

# VII Program

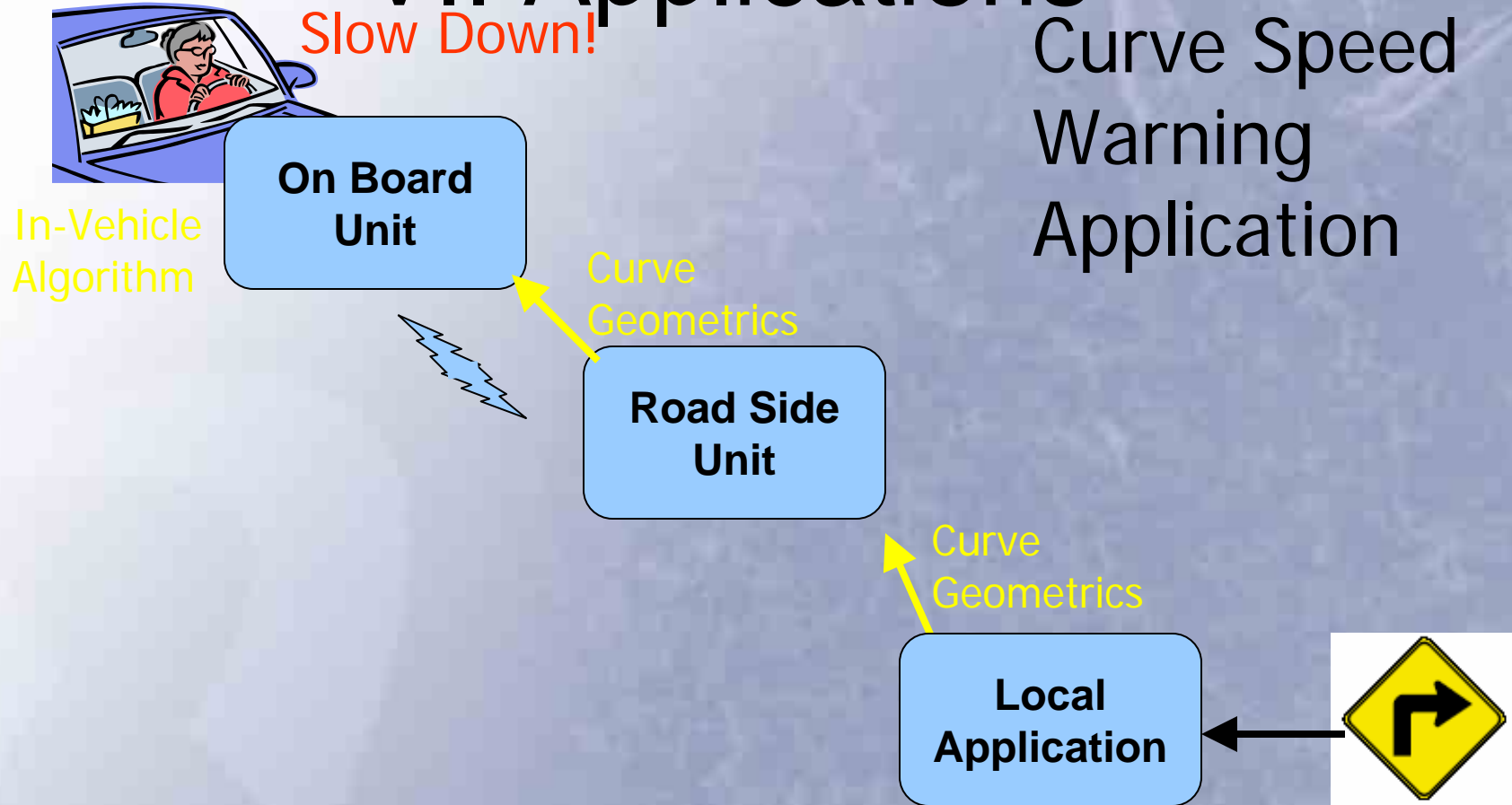


## VII Applications (Use Cases)

- 110 + Applications Identified
  - Safety, Mobility, Other
  - Public, Private, Shared
- Example Applications:
  - Traffic signal violation warning
  - In-Vehicle Highway Signage
  - Vehicles As Traffic Probes
  - Electronic Payment

# VII Applications

## Curve Speed Warning Application



## VII Applications

- Sample Commercial Applications:
  - Internet Access
  - Entertainment Media Downloads
  - Vehicle Diagnostics/Software Updates
  - Gas & Food Electronic Payment
  - Stolen Vehicle Tracking

## VII Issues

- Technical Issues
- Nationwide Deployment
- Operations and Maintenance
- Business models
- Privacy and data ownership

TRANSPORTATION

Revolution

5 Mississippi Valley  
Conference

# Minnesota Projects

# Vehicles as Sensors

**The purpose of this project is to conduct an initial evaluation of technologies needed for Vehicles as Sensors that include:**

- **In-vehicle software and hardware.**
- **Communication technologies and protocols for communication from vehicle to center via a variety of technologies.**
- **Processing individual vehicle data for fusion into MnDOT's CARS traveler information database.**
- **Formulation of traveler information data for delivery back to vehicles.**

# Project Participants

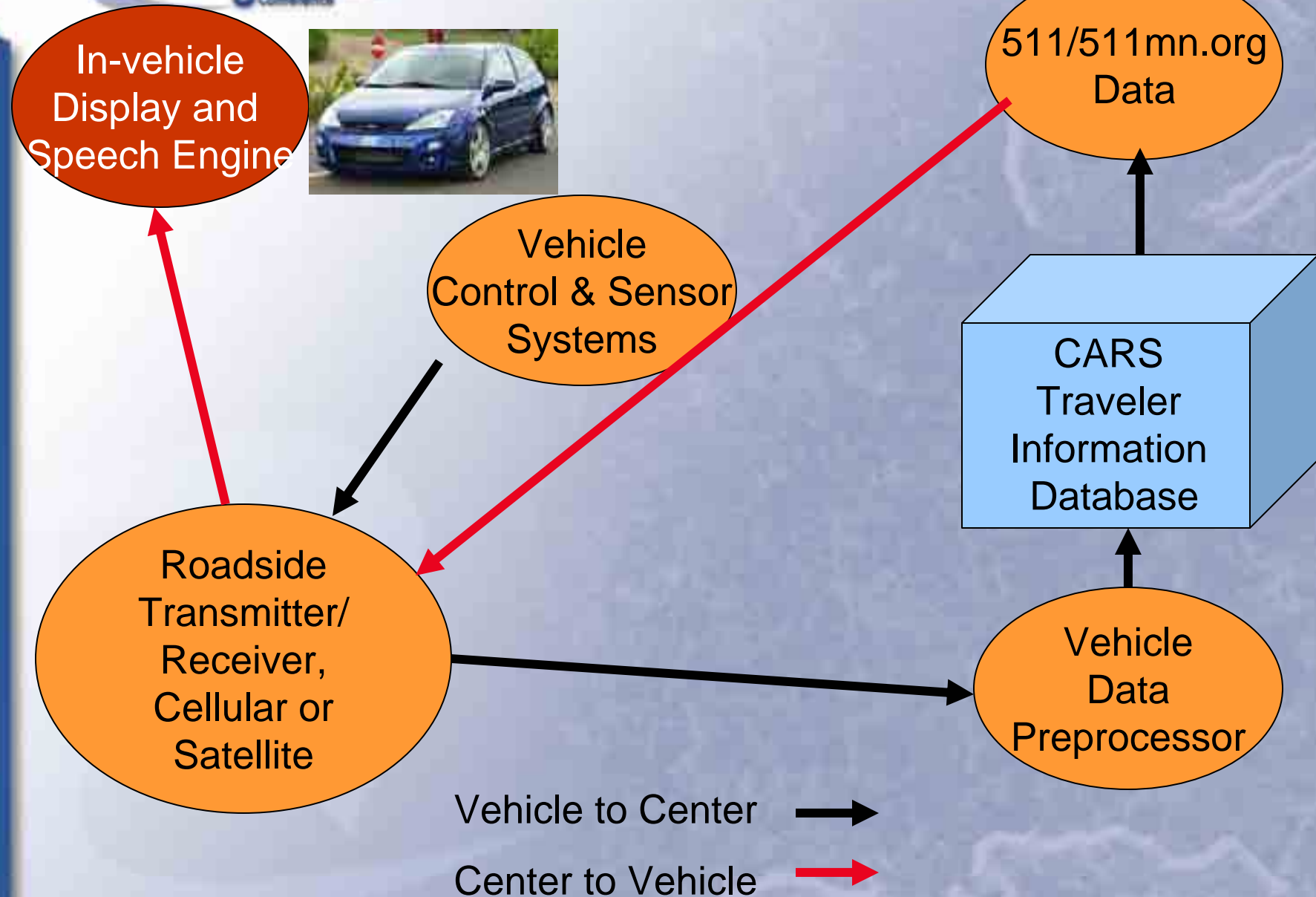
**The following are the project participants:**

- **MnDOT**
- **Minnesota State Patrol**
- **Ford Motor Company Research**
- **Castle Rock Consultants – CARS developer**
- **Innomatixs – Software development**
- **Saturn Systems – Software and installation support**

# General Concept of Vehicles as Sensors

- **Collect the data available from on-board vehicle sensors and computers**
  - **Existing: GPS location, speed, anti-lock braking, lights, wipers, traction control, airbag, etc.**
  - **Additional: pavement**

# Vehicle As Sensors Schematic



# Telematics Unit in Patrol Car



# Present Deployment in Minnesota

- **Vehicle Hardware**

- 10 Municipal vehicle**

- Version 1.0 Telematics**

- Cellular/Data Network**

- GPS**

- Road Temperature**

- **Software**

- Data collection**

- Data transmission**

- Data Display**

# Deployment 06/06/05 in Minnesota

## ▪ Vehicle Hardware

**10 Municipal vehicle**

**Version 2.0 Telematics**

**Wi-Fi (Vehicle-to-Roadside) (Infrastructure Initiation)**

**ACN (Automatic Collision Notification) System**

**ACM (Atmospheric Condition Monitoring) System**

**Cellular/Data Network**

**GPS**

**Road Temperature**

**Surface Roughness**

## ▪ Infrastructure

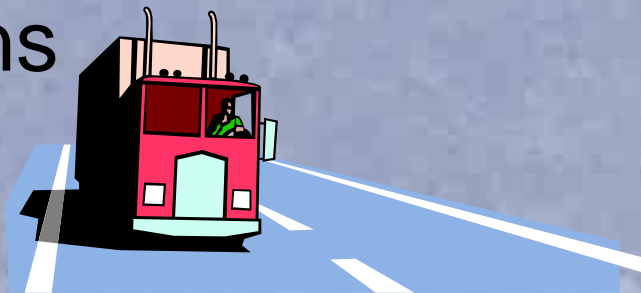
**Vehicle-to-Roadside Communication using Wi-Fi**

**Webpage visualization**

**Cross Country Automotive Support for ACN**

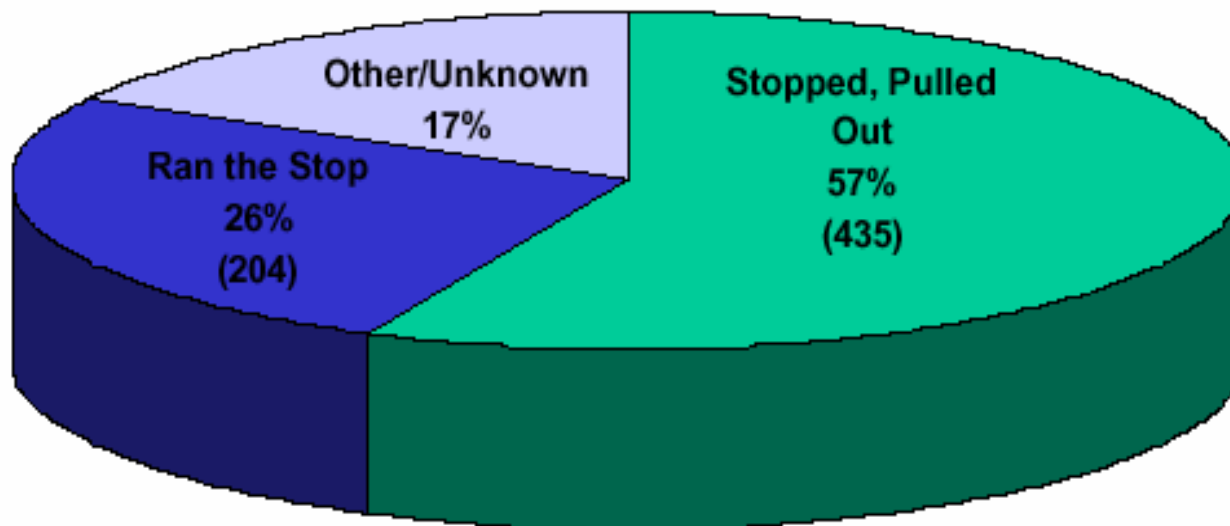
# Intersection Decision Support Minnesota Focus

- Help Drivers Determine a Safe Gap
- Rural Expressway 2-Way Stop Intersections
- Infrastructure Based Detection and Signing



# Stop Sign Gap Assistance

## Distribution of Right Angle Crash Type at Study Intersections



Source: Howard Preston  
CH2MHill

# Stop Sign Gap Assistance Hwy 52 at County Road 9



© 2003 GlobeExplorer, USGS

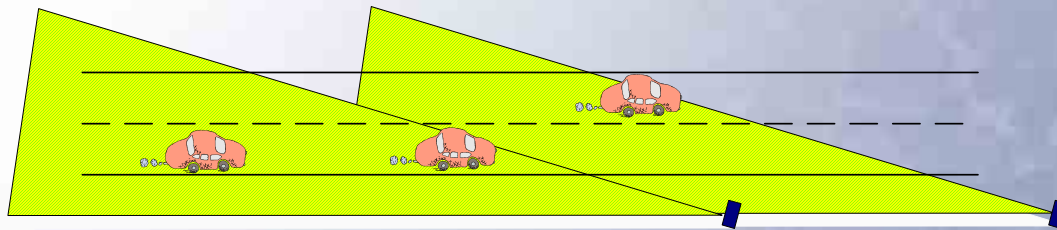
# Restricted Sight Distance

## Different Vertical Alignments

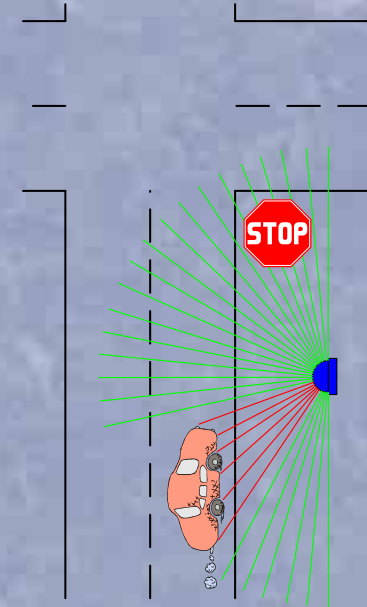


# Intersection Surveillance

Radar Tracking on Main Road



Lidar Classification  
On Cross Street



Video Tracking In Median



# Driver Behavior Data

- Gap Acceptance
  - By Turning Movement
  - By Vehicle Type, Driver, and Weather
- Intersection Maneuvers
  - Minor Street Stop in Median
  - Mainline Reaction to Crossing Vehicle

# Driver Interface (Sign) Simulation



- Evaluate Potential Sign Concepts
- Driver Simulation Evaluation of a Few Concepts

# Potential Driver Interface Concepts



# Human Factors Recommendation for Further Development



**Split Hybrid:**  
-Symbol  
-Countdown



**Icon:**  
-Prohibitions  
-Vehicles

# Thank you!

## For More Information contact:

- <http://www.its.dot.gov/vii>